The Use of Radiography for the Study and Identification of Spiral Marine Shells

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(Plates 24 and 25)

INTRODUCTION

Radiography is a particularly valuable tool for the study of hard tissues, and is capable of revealing internal structures which ordinarily are hidden by overlying calcifications, or which may be covered by soft tissues in the living animal. The use of radiographs for the study of various shells is an old one, and a number of authors have published photographs of radiographs as well as skiagrams of various shell specimens, e. g. Moore (1955), Abbott (1954), Van Benthem Jutting (1952). Thompson (1942) reproduced the radiograph of a shell taken in 1897. Considering the value of the method and its long-time utilization, it is surprising that so little has been done with it in studying the various organisms with either internal or external shells.

The radiograph may be used to show degrees of calcification of various structures, the presence of incremental lines, the spiral forms of growth, major axes in growth, and other features. Excellent radiographs showing these features have been illustrated by Cornwall (1959). Several techniques useful in studying shells radiographically and by other methods, including tracings of radiographic outlines and methods of orienting shells of the same species so that comparable radiographs may be taken, have been described by Speer & Herzberg (1961).

In addition to confirming the above uses of radiography, it is the aim of the present study to indicate its value as an additional means of identification for detecting various taxonomic levels, notably the family, in certain molluscan forms.

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MATERIAL AND METHODS

Spiral shells of 12 families of marine gastropods identified at the generic and species level served as basis for this study.

All shells were radiographed with a standard dental roentgen-ray machine using the long cone technique at 67 kilovolts and 10 milliamperes, with a focal distance of 25 cm. The radiographs were photographed so that positive prints could be made, and these are presented for each specimen in this report.

RESULTS

The family Muricidae in Plate 24, Figures 1 to 7 is represented by 7 species in 6 genera. While each species shows distinguishing features, including differences in ornamentation and in serrations of the shell lip, the family resemblance in columellar structure and general form of the shell is evident. It seems likely that the differences in apical angles may be characteristic of a genus, but the number of specimens available is insufficient to support this contention.

The family Trochidae, with 2 genera, each with 4 species, is illustrated in Plate 24, Figures 8 to 15. The genus *Tegula* shows a blunted and obtuse apical angle in each of the 4 species, while the genus *Calliostoma* shows a sharply pointed acute apical angle in its 4 species. In the case of the family Trochidae the 2 genera shown are clearly distinguishable from each other not only by differences in apex, but also by distinctly different columellar form and varying nature of their respective whorls. The sharp-

ness of the radiographic features of *Calliostoma* as compared to *Tegula* also are obvious. The species *C. tricolor,* while placed in the genus *Calliostoma,* appears to be almost intermediate in form between *Calliostoma* and *Tegula.* The radiographs of the genus *Tegula,* taken from above, clearly show the logarithmic spiral form of the shell.

Plate 25, Figures 16 and 17 show 2 genera, one species each, of the family Turridae. The 2 genera appear radiographically to be identical and could not be separated from each other on the basis of these photographs. Only family identification is feasible in this instance.

One species of the genus *Littorina,* family Littorinidae, is shown in Figure 18 of Plate 25.

The family Nassariidae is represented by 2 species of the genus *Nassarius,* in Figures 19 and 20. The acute apical angle appears to be characteristic of the genus, while the speckled form of shell calcification might well distinguish the species *N. perpinguis* from *N. fossatus.*

In Figures 21 and 22 are illustrated 2 species of the genus *Olivella,* of the family Olividae. These specimens resemble each other at the generic level.

Figures 23 to 28 show species from several families of spiral marine shells, and illustrate some of the variations mentioned between the several families, genera and species.

Figure 23: *Mitra idae,* Mitridae showing an unusual internal spiral centered around the columella.

Figure 24: *Norrisia norrisii,* Turbinidae.

Figure 25: *Zonaria spadicea,* Cypraeidae.

Figure 26: *Polinices reclusiana,* Naticidae.

Figure 27: *Cerithidea californica,* Cerithiidae.

Figure 28: *Conus californicus,* Conidae.

DISCUSSION

From the evidence presented it appears logical to assume that the radiographic method could be used to assist in the identification of the spiral forms of shells at the level of the family, sometimes at the level of the genus, and some specimens probably could be identified as to species (Figures 19 and 20). Since the internal and external hard tissues of the shell vary little, if at all, from specimen to specimen of the same species, this tissue, because of its durability, could be used for making more positive identifications. Standards could be established for such identification if the various species were radiographed and a permanent record of their characteristics made. The simplicity of the radiographic technique would make such a project feasible for any investigator having the appropriate specimens available. This method could also be usefully applied to freshwater and land forms.

Explanation of Plate 24

Radiographs of shells of the family Muricidae

Figure 1: Two specimens of *Maxwellia gemma* (Sowerby, 1879)

Figure 2: Two specimens of *Ceratostoma nuttallii* (Conrad, 1837)

Figure 3: Two specimens of *Shaskyus festivus* (Hinds, 1844)

Figure 4: *Thais emarginata* (Deshayes, 1829)

Figure 5: *Thais* spec.

Figure 6: *Ocenebra circumtexta* Stearns, 1871

Figure 7: *Acanthina spirata* (Blainville, 1832)

Radiographs of shells of the family Trochidae

Figure 8: *Tegula eiseni* Jordan, 1936. The lower photograph is a view of the shell taken from the apex to show its logarithmic spiral form.

Figure 9: *Tegula funebralis* (A. Adams, 1854). Longitudinal and cross sectional views of two different specimens.

Figure 10: *Tegula brunnea* (Philippi, 1848). Longitudinal and cross sectional views of the same specimen.

Figure 11: *Tegula aureotincta* (Forbes, 1850). Longitudinal and cross sectional views of the same specimen.

Figure 12: *Calliostoma canaliculatum* (Humphrey, 1786)

Figure 13: *Calliostoma gemmulatum* Carpenter, 1864

Figure 14: *Calliostoma annulatum* (Humphrey, 1786)

Figure 15: *Calliostoma tricolor* Gabb, 1865

Explanation of Plate 25

Radiographs of shells of the family Turridae

Figure 16: *Burchia redondoensis* (Burch, 1938)

Figure 17: Two specimens of *Pseudomelatoma torosa* Carpenter, 1865

Radiograph of a shell of the family Littorinidae

Figure 18: *Littorina planaxis* Philippi, 1847

Radiographs of shells of the family Nassariidae

Figure 19: Three specimens of *Nassarius fossatus* (Gould, 1862)

Figure 20: Two specimens of *Nassarius perpinguis* (Hinds, 1844)

Radiographs of shells of the family Olividae

Figure 21: Two specimens of *Olivella biplicata* (Sowerby, 1825)

Figure 22: *Olivella baetica* Marrat in Sowerby, 1871

Radiographs of shells of several marine gastropod families

Figure 23: Two specimens of *Mitra idae* Melvill, 1893 Mitridae.

Figure 24: Two specimens of *Norrisia norrisii* Sowerby, 1838 Turbinidae.

Figure 25: *Zonaria spadicea* (Swainson, 1823) Cypraeidae.

Figure 26: Two specimens of *Polinices reclusiana* (Deshayes, 1839) Naticidae.

Figure 27: *Cerithidea californica* (Haldeman, 1840) Cerithiidae.

Figure 28: *Conus californicus* Hinds, 1844 Conidae.

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Figure 7

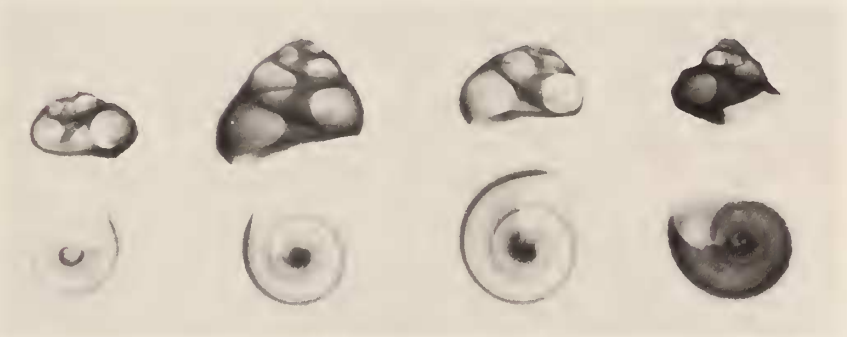

Figure 8 Figure 9 Figure 10 Figure 11

Figure 12 Figure 13 Figure 14 Figure 15